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climatic changes of the glacial period resulted from the combined influence of precession of the equinoxes and secular changes in the eccentricity of the earth's orbit. In favor of this view, the mean temperature of the globe was lowered, and the ratio of the precipitation increased; the dominant set of the currents in the Atlantic was from north to south in the colder terms. In the interglacial climates the summers were cooler and the winters warmer, while the Atlantic currents flowed northerly. The maximum glaciation came early, succeeded by cold epochs of diminishing severity. Glacial epochs in the northern hemisphere were necessarily contemporaneous with interglacial conditions in the southern hemisphere. Hence the astronomical theory would appear to offer the best solution of the glacial puzzle; while it is conceded that this answer is not completely satisfactory.

C. H. HITCHCOCK.

*Biological Lectures and Addresses*, by ARTHUR MILNES MARSHALL. Macmillan & Co., New York. Price \$2.25.

*Lectures on the Darwinian Theory*, by ARTHUR MILNES MARSHALL. Macmillan & Co., New York. Price \$2.25.

It was a curious coincidence by which accidents in mountain climbing deprived English science of two of its prominent biologists, and two who were at the same time personal friends. Prof. F. M. Balfour, as every one remembers, lost his life in a journey in the Alps, and Prof. Arthur Milnes Marshall, upon the last day of 1893, in a somewhat similar manner, met his death in mountain climbing. Prof. Balfour and Prof. Marshall were personal friends and naturally worked upon kindred subjects, although their work was very unlike. Prof. Marshall was still a young man, only about forty years of age. Early in life he entered upon studies looking toward the profession of medicine, but in 1879 gladly accepted the

chair of Zoölogy in Owens College, and continued to occupy the chair until his death.

His additions to the literature of science have been of two general types. There are first a series of papers embodying the results of original research. These, because of his intimate association with Balfour, were at first of an embryological nature, while some of the later ones were more distinctly anatomical. His chief contributions to science of this sort were upon the *Segmental value of Cranial Nerves*, the *Pennatulida of the Porcupine and Triton Expeditions*, and upon *The Nervous System of the Crinoids*. The second class of his papers were more distinctly characteristic of his special powers. They were of a more general character and included a text-book on *The Frog*, on *Practical Zoölogy*, and a more recent work upon *Vertebrate Embryology*. In addition, we have in the recent posthumous volumes a large number of lectures and addresses given in various places before various societies.

Above all things, Professor Marshall was a teacher. It was in this direction that his powers showed at their best. He had the happy way of putting subjects so that they were intelligible to his audiences, and had the somewhat unusual power of putting himself in the position of his audiences, in such a way that he could understand how and what was needed in his teaching to render his subjects clear. His lectures were always abundantly illustrated both by drawings, and especially by homely though terse illustrations. His illustrations for rendering scientific facts intelligible were drawn sometimes from the most surprising sources, and altogether rendered his addresses and his class lectures of the very highest character in the way of scientific teaching. Since his death Macmillan & Co. have published his collected lectures and addresses in the two volumes which are the subject of this notice. The first series consists of miscellaneous addresses given by him at various intervals

between 1879 and the time of his death, and before a number of debating societies and scientific organizations, ending with his presidential address before the British Association in 1890. These addresses are all designed for a somewhat popular audience, and treat of different scientific subjects in a clear, entertaining manner. Among the most interesting of them the lectures that will, perhaps, first commend themselves to the reader are those on Fresh Water Animals, on Inheritance, on Shapes and Sizes of Animals, and the one upon the Recapitulate Theory. Professor Marshall possessed in a wonderful degree the power of seizing hold of the salient points of abstract scientific subjects and isolating them from the cumbersome mass of details with which they are associated in ordinary scientific discussions. The result is that in a few pages the reader obtains a clearer conception of the salient points in a subject like embryology by reading the last of the essays in this volume than he might obtain from the careful perusal of many lengthy books upon the subject. Details, of course, are left out, but the salient and interesting points which embryology teaches and attempts to teach are presented with wonderful clearness. The addresses are, in short, popular science of the highest type, and one does not wonder after reading them that Professor Marshall was one of the most popular lecturers in the University Extension courses.

Every teacher is aware how difficult it is to send a young student to literature that will give him a clear, succinct account of evolution. Scientific discussions of one and another phase of the subject are abundant, but usually they are beyond the comprehension of the ordinary reader. Many a student having been recommended to read Darwin's *Origin of Species* reads the book with an utter failure to comprehend Darwinism. Nor is this the fault of the student. Even the better class of thinking students

are so handicapped by the abundance of material in that Darwinian classic that the thread of the argument is lost, and they are just as likely to confuse Darwin's views with those of Lamarck as they are to understand Darwinism. Few students who are beginning the study of modern biology will have any proper appreciation of Darwinism from the study of the *Origin of Species*, or, indeed, from the study of most of the scientific writings on evolution, unless the essential facts are presented to them in some form of introduction. For this reason the series of lectures on the Darwinian theory by Professor Marshall are especially valuable. These lectures are not encumbered with numerous details, but seize hold of the thread of the Darwinian argument and present it before the reader in such a way that he cannot fail to understand evolution and Darwinism after having finished such a volume. This series of essays will, therefore, be perhaps the best literature to which a student can be sent at the present time to enable him to understand what evolution was before Darwin, what Darwin added, and what have been the subsequent modifications and criticisms of Darwin's theory. Professor Marshall writes as a partisan and thorough believer in Darwin, and presents his facts in such a way that his readers cannot fail to recognize the full force of the Darwinian argument. Indeed, he naturally exaggerates the force of many arguments, frequently begs the very question of the issue, and the essays are by no means calculated to be critical discussions. The lectures cannot be considered as a fair presentation of the Darwinian theory. The innocent reader will conclude that the argument upon Darwinism is all on one side, that every essential feature of it is abundantly demonstrated and all criticisms are refuted. But, in spite of this fault, which comes naturally from one who is attempting to teach a theory in which he so fully believes,

the outline of the Darwinian theory is an exceptionally good one. Certain it is that nothing in our literature at the present time will give such a terse, clear presentation of the Darwinian hypothesis with the arguments in its favor, and of the additions which have been made to this hypothesis subsequent to the writings of Darwin himself.

These two books are, then, designed for popular reading. They are perhaps as good an illustration of the especial character of Prof. Marshall's power in teaching as could be found. They are valuable additions to that class of books in which the English language is beginning to abound, viz., popular scientific writings that actually *teach science*.

H. W. CONN.

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*Elements of Astronomy*.—By GEORGE W. PARKER, of Trinity College, Dublin. Longmans, Green & Co., London and New York. 8vo., 236 pages. \$1.75.

The book is designed as a connecting link between the elementary school-astronomies and the higher treatises used as text-books in the universities. It treats the subject almost exclusively from the geometrical point of view, breaking up the matter into propositions, corollaries and problems, arranged in an order which is probably logical enough in its mathematical sequence, but strikes one as rather peculiar. The book will be found useful by teachers who have 'examination papers' to draw up, since it presents a large number of them, as well as numerous 'exercises' and problems well suited to test a student's understanding of the subject-matter.

What the book professes to do is in the main very well done. The statements and definitions are intelligible and correct, and the reasoning is generally clear and logical. The writer's description of the instruments and methods of practical astronomy make

it evident, however, that he has had very little actual experience in that sort of work. It reads rather strangely, for instance, to be told that the way to find the value of a micrometer-screw revolution is to 'note how many turns correspond to the sun's diameter.'

Regarded as an elementary presentation of 'Astronomy' taken as a whole, the book must be pronounced extremely one-sided and defective. Astrophysics is most inadequately dealt with; the whole subject of spectroscopy is dismissed with six pages and a single old diagram of the dispersion of light by a prism; and all physical matters relating to sun, planets, comets, stars and nebulae are treated on the same general scale.

C. A. Y.

*Qualitative Chemical Analysis of Inorganic Substances*.—As practiced in Georgetown College, D. C. American Book Co., New York. 1894.

Rev. H. T. B. Tarr, S. J., formerly professor of chemistry in Georgetown College, prepared a series of tables for analytical purposes, which have been wholly recast and incorporated into the work now before us. The present editor, Rev. T. W. Fox, S. J., speaks of the book as being 'useful in a course such as is given at Georgetown and in similar institutions throughout the country.'

The 'grouping of the bases' is that generally adopted by writers on qualitative analysis the world over. We believe, however, that it would have been wiser and better for the student had the author divided his third group, consisting of the metals precipitated by ammonium sulphide from neutral or alkaline solutions, into two groups. But this is merely a matter of opinion.

We observe that the properties of the metals are first studied, after which the author draws up a table for the analysis of